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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte CLAUS ERDMANN FURST, IGOR MUCHA, and LARS STENBERG

Appeal 2009-004718
Application 09/964,893
Technology Center 2600

Decided: March 23, 2010

Before JOHN C. MARTIN, MAHSHID D. SAADAT, and CARLA M. KRIVAK, *Administrative Patent Judges*.

MARTIN, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

This is an appeal under 35 U.S.C. § 134(a) from the Examiner's November 27, 2007, nonfinal Office Action (hereinafter "Office Action")

rejecting claims 1, 5, 7, 17, 18, 36, and 38, which are all of the pending claims.

We have jurisdiction under 35 U.S.C. § 6(b). We affirm.

A. Appellants' invention

Appellants' invention is a microphone assembly. Specification 1:5.[1] Figure 2 is reproduced below.

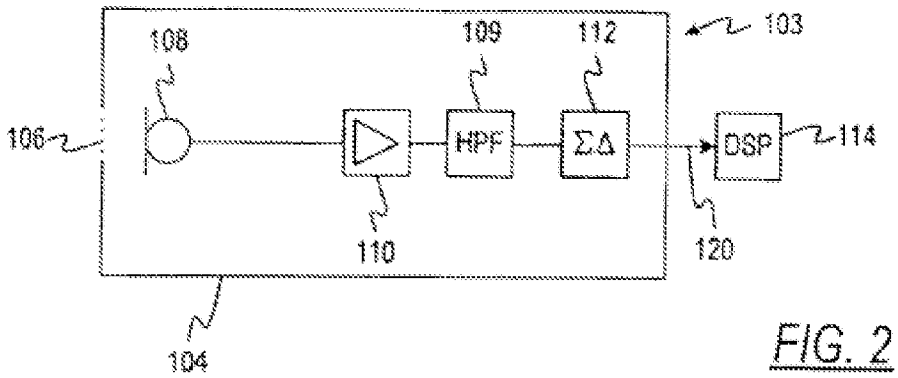

FIG. 2

Figure 2 is a functional diagram of an alternative embodiment of a microphone assembly in accordance with Appellants' invention (*id.* at 9:26-27). It is apparent from a comparison with the description of the Figure 1 embodiment (*id.* at 8:10-24) that numeral 106 designates a sound inlet port in a microphone assembly casing 104. The Figure 2 embodiment further includes a high-pass filter 109 connected between microphone pre-amplifier

[1] References herein to Appellants' Specification are to the Application as filed rather than to corresponding Patent Application Publication 2002/0106091 A1.

110 and an A/D (analog-to-digital) converter 112, which preferably is a sigma-delta modulator (*id.* at 7:26-27). The high-pass filter 109 blocks DC components in the signals between microphone pre-amplifier 110 and A/D converter 112 and also reduces the overall noise level in the microphone assembly 103 by filtering out low frequencies (*id.* at 7:28-31).

B. The independent claim

The sole independent claim before us is claim 1, which reads:

> 1. A microphone assembly comprising
>
> - a microphone assembly casing having a sound inlet port,
>
> - a transducer for receiving acoustic waves through the sound inlet port, and for converting received acoustic waves to analog audio signals, said transducer being positioned within the microphone assembly casing,
>
> - an electronic circuit positioned within the microphone assembly casing, said electronic circuit comprising a signal path defined by a cascade of
>
> - a pre-amplifier for amplifying analog audio signals from the transducer, and
>
> - a sigma-delta modulator for providing digital audio signals,
>
> wherein the microphone assembly further comprises filter means in the signal path between the pre-amplifier and the sigma-delta modulator, the filter means preventing low frequency components from reaching the sigma-delta modulator.

Claims App. (Br. 15).

C. The references

The Examiner relies on the following references:[2]

Martin	US 5,796,848	Aug. 18, 1998
Arndt et al. ("Arndt")	US 6,421,448 B1	July 16, 2002

D. The rejection

Claims 1, 5, 7, 17, 18, 36, and 38 stand rejected under 35 U.S.C. § 103(a) for obviousness over Martin in view of Arndt.

THE ISSUE

The principal issue raised by Appellants' arguments is whether Arndt suggests using an electrical (as opposed to only an acoustic) high-pass filter for blocking or suppressing low-frequency components in a microphone signal.

ANALYSIS

Martin's invention is an improved digital hearing aid designed to be substantially insensitive to emission of high-frequency electromagnetic waves. Martin, col. 1, ll. 36-39, 49-54. In the "Background of the Invention," Martin discusses a prior art hearing aid that includes, in series, a microphone, an amplifier that forms a low-pass filter, an A/D (analog-to-

[2] Because the availability of the references as prior art against Appellants' claims is not at issue, only the issue or publication dates are being provided.

digital) converter, a computer stage for performing digital processing, a digital-to-analog converter, an output amplifier, and an output transducer (col. 1, ll. 11-18). High-frequency electromagnetic waves from automobile telephones, mobile radio equipment, or microwave irradiation means can "penetrate into the hearing aid through openings and have a disturbing influence on the amplifier circuit" (col. 1, ll. 30-39).

Martin reduces the sensitivity of a hearing aid to such high-frequency electromagnetic waves by integrating the A/D converter into the microphone housing so that only digital signals, which are largely insensitive to noise, are communicated from the microphone housing to the signal-processing components (signal processing stage, output amplifier) (col. 1, ll. 55-62). The A/D converter preferably takes the form of a sigma-delta modulator (col. 1, l. 62 – col. 2, l. 4).

Martin's Figure 2 is reproduced below.

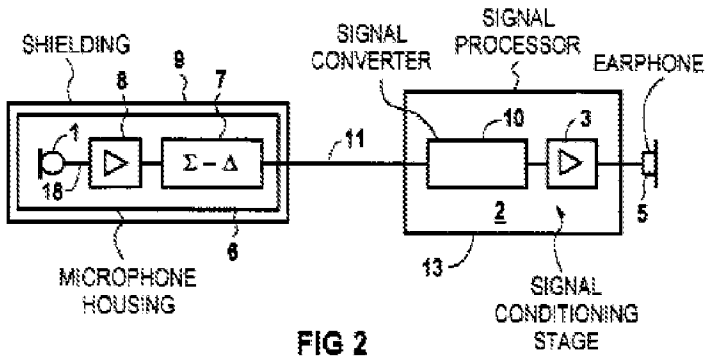

FIG 2

Figure 2 shows an embodiment of a hearing aid having a shielded microphone housing 6 that houses a microphone 1, pre-amplifier 8, and a sigma-delta modulator 7 (col. 2, ll. 25-28, 41; col. 3, ll. 13-19). The Examiner found (Answer 3), and Appellants do not deny, that Martin

satisfies all of the limitations of claim 1 except for the recited "filter means in the signal path between the pre-amplifier and the sigma-delta modulator, the filter means preventing low frequency components from reaching the sigma-delta modulator." For a suggestion of adding such a filter to Martin, the Examiner relies on Arndt.

Arndt's invention is a method for producing a directional microphone characteristic in a hearing aid device having two microphones that are of the same type but deviate from one another in their signal transmission behavior. Arndt, col. 1, ll. 53-57.

Arndt's Figure 1 is reproduced below.

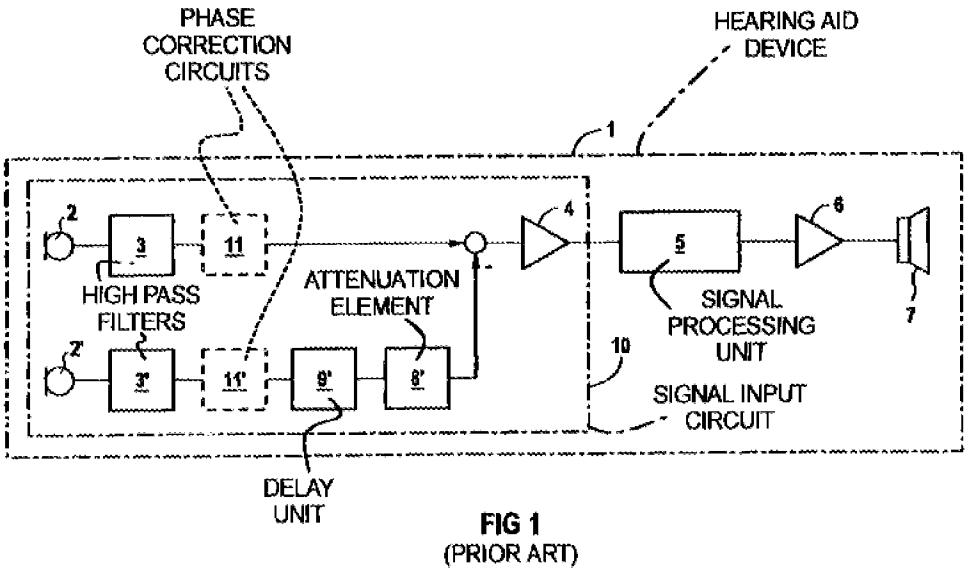

FIG 1
(PRIOR ART)

Figure 1 is a block circuit diagram of a known hearing aid device 1 (col. 3, ll. 51-52). Signal input circuit 10 includes, *inter alia*, two electroacoustic input transducers 2 and 2' followed by high-pass filters 3 and 3', respectively (col. 3, ll. 51-54). In order to attain a directional microphone

characteristic, the output signal of the microphone 2' is delayed by a signal delay unit 9 and subtracted from the output signal of microphone 2 by an attenuation element 8 provided with a corresponding weighting, with the resulting difference signal being forwarded to a signal pre-amplifying unit 4 (col. 3, ll. 54-60). A known option for allowing greater microphone tolerances is the insertion of specific correction circuits 11 or 11' into the signal paths of the input signals, but such circuits are relatively complicated (col. 4, ll. 9-12).

Arndt's Figure 2, on which the Examiner relies, is reproduced below.

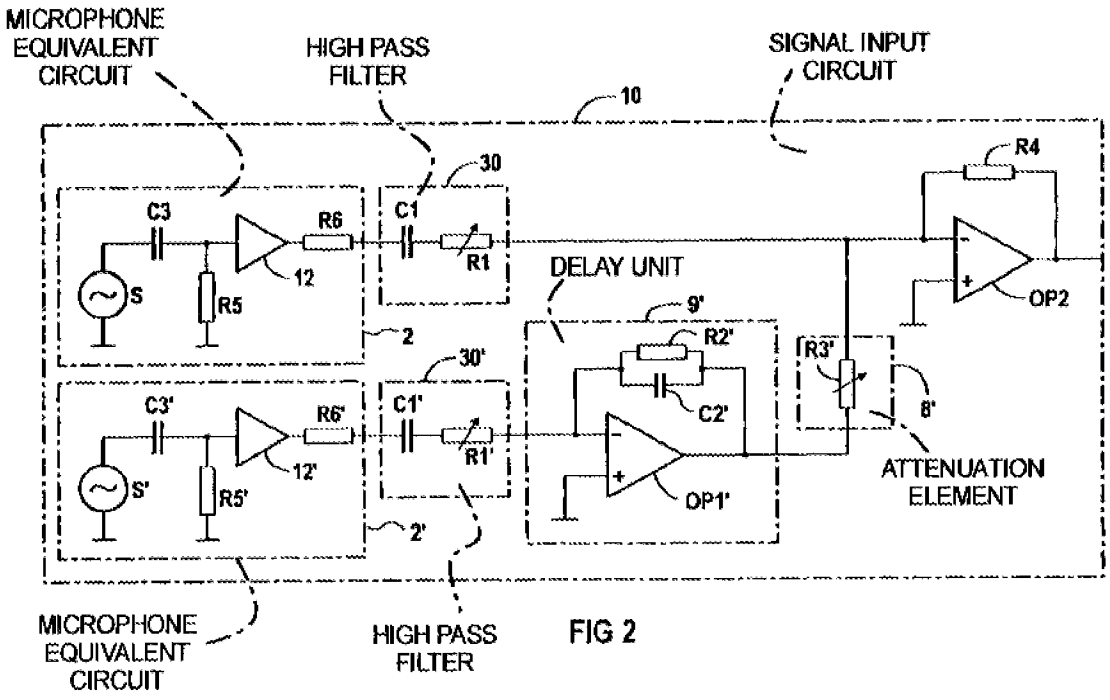

FIG 2

Figure 2 is a circuit diagram of an exemplary embodiment of a hearing aid device employing the method of Arndt's invention (col. 3, ll. 44-46).

Microphones 2 and 2' are illustrated as microphone equivalent circuits, each of which includes a signal source (S, S') followed by a high-pass filter comprising a capacitor (C3, C3') and a resistor (R5, R5') (col. 4, ll. 20-27). Each of these high-pass filter circuits represents an acoustic high-pass filter created by forming a small hole in the microphone membrane such that the lower limit frequency lies on the magnitude of 100 Hz, although higher or lower limit values are also possible (*id.*). This acoustic high-pass filter is used to suppress interference signals of lower frequency, as occur in a car, for example, which signals otherwise could easily lead to over-amplification in the hearing aid device (col. 2, ll. 41-58). Arndt also explains that "[m]icrophones customarily used in hearing aid devices nowadays represent acoustic high-pass filters in their signal transmission behavior" (col. 2, ll. 36-38).

Each of electrical high-pass filters 30 and 30', which are located subsequent to the microphone equivalent circuits, contains a coupling capacitor (C1, C1') and a resistor (R1, R1') (col. 4, ll. 34-36). In the passage that is the basis for the rejection, Arndt explains that "[t]his arrangement of a coupling capacitor and a resistor is a *customary circuit* for coupling a microphone signal into an amplifier circuit, e.g. of a hearing aid device" (col. 4, ll. 36-39) (emphasis added). In accordance with Arndt's invention, the limit frequency of each high-pass filters (30, 30') is matched to the limit frequency of the acoustic high-pass filter characteristic of the microphone in the other signal path. That is, the values of the programmable resistors R1 and R1' are selected such that the limit frequency of the microphone 2

corresponds to the limit frequency of the high-pass filter 30' and the limit frequency of the microphone 2' corresponds to the limit frequency of the high-pass filter 30 (col. 4, ll. 42-48). In this way it is possible to balance manufacturing-related variation of the limit frequencies of the microphones used (col. 4, ll. 48-50).

The Examiner's reliance on Arndt (Answer 4) is limited to Arndt's above-noted characterization of the arrangement of a coupling capacitor (C1, C2) and a resistor (R1, R2) in each of high-pass filters 30 and 30' in Figure 2 (not reproduced herein) as "a customary circuit for coupling a microphone signal into an amplifier circuit, e.g. of a hearing aid device." Arndt, col. 4, ll. 35-40. Regarding this "customary circuit," the Examiner further found that "it is well recognized in the audio or electronic art that an ordinary or customary high pass filter (30 or 30' as shown by Arndt) is generally used to suppress or filter out [a] low frequency signal that is usually considered as noise or disturbance signal" (Answer 5-6) and also that "[i]t is clear to one of ordinary skill in that art that such ordinary or customary high pass filter would have provided [the] inherent benefit of attenuating or suppressing or preventing the low frequency noise or interference signal being applied into the high pass filter" (Answer 6). The Examiner then concluded that

> it would have been considered obvious to the combined teachings of the references (i.e[.], Martin and Arndt) by providing or coupling [sic] a customary high pass filter in signal path between the pre-amplifier and the sigma-delta modulator of Martin in order to attenuating or suppressing the low frequency band interference signal of the microphone input thus to prevent low frequency components from reaching the sigma-delta modulator to ensure

> more efficient signal processing by hearing aid signal processor of Martin . . . .

(*Id.*)

Appellants have responded with several arguments. The first argument (Reply Br. 6) is based on Arndt's discussion in the "Background of the Invention" of a known, directional microphone in which "[a] series-connected microphone, coupling capacitor and resistor are, respectively, located in two separate signal paths which are interconnected with one another to produce a directional microphone characteristic." Arndt, col. 1, ll. 21-24. As noted by Appellants (Reply Br. 6), Arndt explains that

> [a] disadvantage of this known circuit is that the desired directional characteristic can be attained only if the two microphones deviate at the most only negligibly from one another with regard to their signal transmission behavior. In the output signal of the two microphones, a phase difference of more that 3° in the frequency range in which the directivity is to be attained already acts negatively on the desired directional characteristic of the arrangement.

Arndt, col. 1, ll. 29-33. Based on this passage, Appellants argue that "in conventional hearing aids having two microphones, Arndt teaches that the desired directional characteristic can only be attained if the phase of the signals from each microphone deviates from the other microphone by less than 3° in the frequency range." (Reply Br. 6.) The relevance of this teaching to the rejection before us is not apparent, because the hearing aid depicted in Martin's Figure 2, on which the rejection is based, has a single microphone.

Appellants also argue that "Arndt fails to suggest that the high-pass filters 30 and 30' are used to 'suppress or filter out' low frequency signals" (Reply Br. 5) because Arndt, in discussing the Figure 2 embodiment, attributes this function to the small holes in the membranes of the microphone and instead describes high-pass filters 30 and 30' as being used only for matching their limit frequencies to the limit frequencies of the acoustic high-pass filters of the microphone's acoustic high-pass filters. (*Id.* at 7.) This argument is not responsive to the rationale of the rejection, which is not based on how high-pass filters 30 and 30' function in the Figure 2 embodiment. Instead, the Examiner relies on that embodiment merely to show the arrangement of the "coupling capacitor and a resistor" that comprise the disclosed "*customary circuit* for coupling a microphone signal into an amplifier circuit" (col. 4, ll. 38-39) (emphasis added).

Appellants also argue that assuming for the sake of argument that it would have been obvious to combine the teachings of Martin and Arndt, "the combination of Martin and Arndt would motivate one having ordinary skill in the art to place a small hole in the membrane of the microphone as taught by Arndt, not a 'filter means in the signal path between the pre-amplifier and the sigma-delta modulator' as recited in independent claim 1." (Br. 13.) We disagree for the following reasons. Appellants have not argued the Examiner erred in making the above-quoted finding that "it is well recognized in the audio or electronic art that an ordinary or customary high pass filter (30 or 30' as shown by Arndt) is generally used to suppress or filter out low frequency signal that is usually considered as noise or

disturbance signal." (Answer 5-6.) We find that a person skilled in the art would have understood that Arndt's disclosed technique of creating an *acoustic* high-pass filter by forming a hole in the microphone diaphragm is an alternative to using an *electrical* high-pass filter in the form of the "customary circuit." We further find that a person skilled in the art would have recognized from Arndt that either of these two types of high-pass filters can be used to block or suppress undesirable low-frequency components in a microphone system that has a single microphone, such as Martin's Figure 2 embodiment. Arndt's above-noted disclosure that "[m]icrophones customarily used in hearing aid devices nowadays represent acoustic high-pass filters in their signal transmission behavior" (col. 2, ll. 36-38) does not constitute a criticism of using electronic high-pass filter circuits with microphones and thus does not amount to a teaching away from their use. *Cf. Depuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) ("A reference does not teach away . . . if it merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the invention claimed.") (internal quotation marks omitted). Consequently, we conclude that it would have been obvious from Arndt to modify Martin's Figure 2 embodiment to prevent low-frequency signals from reaching the sigma-delta modulator either by using a microphone that has an acoustic high-pass filter characteristic or by adding a separate electric high-pass filter located inside microphone housing 6. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) ("When there is a design need or market pressure to solve a problem

and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.").

Appellants additionally argue that even assuming it would have been obvious to add one of Arndt's high-pass filters 30 and 30' to Martin's Figure 2 embodiment, the high-pass filter would be located *outside* rather than inside the recited "microphone assembly," which term Appellants apparently would have us limit to Arndt's microphone equivalent circuits 2 and 2':

> [T]he high-pass filters 30 and 30' are positioned outside of the microphone equivalent circuits 2 and 2' as indicated by the dashing line surrounding elements S, C3, R5, R6 and 12. Thus, contrary to the Examiner's assertion, Appellants submit that the Arndt [reference] also fails to teach, or suggest, a microphone assembly including a filter means as similarly recited in independent claim 1.

(Br. 12.) This argument is unpersuasive because the claim term "microphone assembly" is broad enough to embrace all of the components in Martin's microphone housing 6 as modified in view of Arndt to include an electronic high-pass filter.

Finally, Appellants argue that the references fail to specifically suggest locating the high-pass filter between Martin's preamplifier 8 and sigma-delta circuit 7, as is necessary to satisfy claim 1. (Reply Br. 8-9.) As support for this argument, Appellants point out (correctly) that Arndt's high-pass filters 3 and 3' are located upstream from the pre-amplifier 4 in the Figure 1 embodiment and that Arndt's high-pass filters 30 and 30' are

located upstream from operational amplifiers OP1' and OP2 in the Figure 2 embodiment. (*Id.*) While it is true that neither reference specifically discloses locating a high-pass filter between a preamplifier and an A/D converter (e.g., a sigma-delta modulator), we conclude that it would have been obvious to locate the high-pass filter, which is an analog component, in either of the only two possible locations for such an additional analog component in Martin's analog signal path, i.e., either between microphone 1 and pre-amplifier 8 or between pre-amplifier 8 and sigma-delta circuit 7. *See KSR,* 550 U.S. at 421 ("When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.").

For the foregoing reasons, we will sustain the rejection of claim 1 under 35 U.S.C. § 103(a) for obviousness over Martin in view of Arndt as well as the rejection on that ground of dependent claims 5, 7, 17, 18, 36, and 38, which Appellants treat as rising or falling with claim 1. (Br. 8, para. A.) 37 C.F.R. § 41.37(c)(1)(vii) (2007).

DECISION

The Examiner's rejection of claims 1, 5, 7, 17, 18, 36, and 38 under 35 U.S.C. § 103(a) for obviousness over Martin in view of Arndt is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1). *See* 37 C.F.R. § 1.136(a)(1)(v) (2009).

AFFIRMED

gvw

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